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APPLICATION OF IUCN 2001 RED LIST CATEGORIES IN DETERMINING THE CONSERVATION STATUS OF NATIVE ORCHIDS OF VICTORIA, AUSTRALIA

GARY BACKHOUSE* AND DAVID CAMERON

Arthur Rylah Institute for Environmental Research, Department of Sustainability and Environment, 123 Brown Street, Heidelberg, Victoria 3084, Australia.
Email: gary.backhouse@dse.vic.gov.au

ABSTRACT. The conservation status of the 372 taxa of orchids native to the Australian State of Victoria was assessed using the IUCN 2001 Red List categories and criteria. The assessment resulted in the following findings: Extinct, 11 taxa (10 global, 1 regional); Critically Endangered, 79 taxa (70 global, 9 regional); Endangered, 26 taxa (12 global, 14 regional); Vulnerable, 92 taxa (38 global, 54 regional); Near Threatened, 8 taxa (1 global, 7 regional); Data Deficient, 24 taxa (15 global, 9 regional); and Least Concern, 132 taxa. These findings indicate that a high proportion (65%) of Victoria's native orchids are rated as being of Conservation Concern, which reflects the substantial land-use changes, subsequent habitat degradation, and operation of threatening processes occurring across much of the state. Although the assessment was undertaken at a regional scale, the relatively high degree (40%) of endemicity/near endemicity of Victoria's native orchids makes the findings relevant at the global scale. Undertaking such a comprehensive assessment was a major exercise that entailed many challenges, such as varying interpretation and application of the IUCN Red List system, collation of information from disparate sources, and uncertain and changing taxonomy—all of which affected the assessment. The experience gained and lessons learned from the conservation assessment are described.

Key words: IUCN Red List, conservation, orchids, Victoria, Australia

INTRODUCTION

The first comprehensive list of rare or threatened flora (including orchids) in Victoria, prepared by Gullan et al. (1990), has been updated and published on a regular basis ever since. The list has been published as part of the full Victorian flora species list (e.g., Cameron et al. 1998, Cross et al. 2001) or as specific rare or threatened flora lists, such as those by the Department of Sustainability and Environment (DSE 2003) and by the Department of Natural Resources and Environment (NRE 2000). Other threatened flora and threatened orchid lists for Victoria also have been prepared (e.g., Backhouse & Jeanes 1995, Ross 2000, Ross & Walsh 2003). The categories and criteria used in these lists to assign conservation status were based on criteria and categories of the 1980 IUCN Red List (IUCN 1980) as well as Leigh et al. (1981). The 1980–1981 classification system remained in place for about 15 years, with only slight modifications.

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act, Introduction) acknowledged use of modified IUCN 1994 Red List categories and criteria in assigning conservation status for Australian flora and fauna. The 1994 version was a major departure from earlier versions, incorporating the use of more objective criteria in assigning conservation status. In 2001, the Victorian Department of Sustainability and Environment decided to bring Victoria into line with the new national (and international) standard, and commenced updating the state threatened fauna and flora lists by using the current IUCN Red List Categories and Criteria (IUCN 2001 version 3.1). This involved reassessing the conservation status of more than 1700 species of vascular plants considered rare or threatened in Victoria (DSE 2003) using the IUCN 2001 version. Orchids were chosen as the first group of plants to be assessed, because they are relatively well known, have a reasonable database of information available, are the focus of a high level of conservation attention, and are subject to considerable community interest. This paper presents the results of the assessment.

METHODS AND MATERIALS

Study Area

The Australian State of Victoria, which lies in the southeast corner of the continent, is 227,000 km^2 in area (less than 3% of the Australian continent). Despite this small area, Victoria supports a wider range of broad ecosystem types than does any area of comparable size in Australia,

* Corresponding author.

with 27 terrestrial biogeographical regions (bioregions) that have been defined in Victoria (NRE 1997). Elevation ranges from sea level to nearly 2000 m in the Australian Alps, while rainfall varies from less than 250 mm/yr to more than 2000 mm/yr (Duncan 1982). Victoria lies at 34–39°S latitude and has a temperate climate (often described as Mediterranean), with warm to hot dry summers and cool wet winters, marked by large seasonal variability.

Reflecting this diversity of habitats, Victoria has a relatively rich orchid flora with at least 372 orchid taxa in 35 genera, comprising 267 named taxa (264 named species, plus two species each with two named subspecies, and one species with two named varieties) and 105 unnamed taxa, as recorded in the Flora Information System (FSI) published by the DSE (2004). In addition, Victoria has 14 named and at least 70 unnamed, naturally occurring hybrids; and one alien species, the African orchid *Disa bracteata* Sw., now is naturalized in Victoria. The largest genera are *Caladenia* R.Br. with 81 taxa, *Pterostylis* R.Br. with 81 taxa, *Prasophyllum* R.Br. with 65 taxa, and *Thelymitra* J.R. Forst. & G. Forst. with 43 taxa. Some 142 taxa (40%) are either endemic or confined almost entirely to Victoria, and it is estimated that the state has ca. 25% of the total orchid flora of Australia. Almost all native orchids of Victoria are deciduous geophytes (characteristic of temperate regions with marked seasonal variability in climatic conditions), with only five species of evergreen epiphytes or lithophytes (characteristic of sub-tropical and tropical regions) present.

Conservation Status Assessments

The conservation status assessments of the 372 taxa of Victoria's native orchids were undertaken using the IUCN 2001 Red List Categories and Criteria (version 3.1). These categories are Extinct (EX), Critically Endangered (CE), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Data Deficient (DD), and Least Concern (LC).

Data Collection

Application of IUCN 2001 relies on the availability of information including data on number and size of populations, rate of population reduction, extent of occurrence/area of occupancy, and impact of threats for determining conservation status. Data collection forms, based on the information needed for criteria selection in IUCN 2001, were prepared and circulated to professional botanists, conservation managers, community orchid enthusiasts, and others with expertise in native orchids. The conservation status assessments were subsequently undertaken on the basis of the returned completed forms, plus review of hundreds of FIS records. The assessments were prepared in multiple sessions over a 2-year period.

Regional Assessment

The conservation status assessment of Victoria's orchids was made at a regional (i.e., subglobal) level. Ideally, regional application of the IUCN Red List should be biogeographically rather than geopolitically based. In Australia, however, the state and territory governments have primary responsibility for nature conservation within their jurisdiction; and, as such, most states and territories have prepared and maintain lists of threatened flora and fauna. Although Victoria is only a relatively small part of Australia, with about 40% of orchid taxa being endemic or largely confined to Victoria, conservation status assessments for these taxa are effectively global assessments.

Guidelines for the application of the IUCN Red List categories and criteria at a regional level have been prepared (IUCN 2003). Basically the assessment is undertaken as if at the global scale to determine a conservation status category. The assessment then considers whether the target population is isolated from, or contiguous with, populations adjoining the region under consideration; next it considers the impact any movement into or away from the target population may have on extinction risk. Emigration could increase the extinction risk, and immigration could reduce the extinction risk. If immigration into the target population is considered a possibility (thereby decreasing the extinction risk), then the conservation status level is downgraded, typically by one level (i.e., CR to EN, EN to VU, and VU to NT).

Emigration of adults from the target population is not an issue for orchids. Immigration from contiguous/adjoining populations, however, is a possibility that needs to be considered when undertaking a regional conservation status assessment. Virtually all species of orchids have tiny, dust-like seed that is well suited for wind dispersal, although most seed probably falls close to the adult plant, with dispersal distances generally measuring only meters, and probability of dispersal decreasing with distance (Dressler 1981).

The ability of some orchid seed to travel reasonable distances and colonize suitable habitat, however, is well demonstrated. Rasmussen (1995) summarizes information on the dispersal of several European terrestrial orchid species, with dispersal distance of 5–10 km common and longer distances, up to 250 km, being recorded.

At least 63 species of orchids have become established (at least briefly) on the Krakatau islands in Indonesia, in the period since a cataclysmic volcanic eruption in 1883 that was believed to have killed every plant and animal (Partomihardjo 2003). The Krakatau islands are ca. 40 km from the nearest substantial land mass, and seed from some species of orchids that have colonized the islands would have had to travel distances substantially greater than 40 km from the nearest source populations.

Decision Rules

The assessment had to consider the following question: To what extent can orchid dispersal affect the extinction risk of taxa considered threatened in Victoria? To answer this question, several decision rules were developed to help test the application of immigration into Victoria. Populations of the species had to exist in adjoining states contiguous with, or adjacent to, the target population in Victoria. The species had to be relatively common across the state borders (rather than occurring as isolated, disjunct populations). Seed capsule development had to be observed frequently in the source population(s). The habitat where the species occurred in Victoria had to have a high degree of protection. If the habitat was threatened, such as through clearing or weed invasion, the population would have little chance of persisting, even with supplementation through immigration from adjoining populations. The possibility of immigration needs to be considered in a timeframe of years or decades to be meaningful to conservation managers rather than in longer (and perhaps more biologically meaningful) timeframes of hundreds or even thousands of years.

Populations of threatened orchids potentially benefiting from immigration outside the region were deemed to exist only in eastern Victoria, where extensive contiguous habitat exists in southern New South Wales in coastal/foothill and montane/alpine vegetation complexes. Along the western and northern state borders, extensive habitat loss and fragmentation have occurred on both sides of the border, and very few areas provide contiguous habitat across the border. In these instances, immigration was considered a low probability and almost certainly not affecting the extinction risk of taxa in those parts of the state.

RESULTS

The conservation status assessment of the native orchids of Victoria provided the following results (TABLE 1): Extinct (EX), 11 taxa (10 global, 1 regional); Critically Endangered (CR), 79 taxa (70 global, 9 regional); Endangered (EN), 26 taxa (12 global, 14 regional); Vulnerable (VU), 92 taxa (38 global, 54 regional); Near Threatened (NT), 8 taxa (1 global, 7 regional); Data Deficient (DD), 24 taxa (15 global, 9 regional); and of Least Concern (LC), 132 taxa.

This assessment indicates that 197 taxa of orchids (53%) are Threatened, which equals CR + EN + VU. When the Extinct plus Data Deficient plus Near Threatened categories are added to Threatened, 240 taxa (65%) of the total orchid flora of Victoria are considered of Conservation Concern.

Nine species had their initial assessments downgraded by one level because of the possibility of immigration. All have extensive distributions and are common outside Victoria (Bishop 1996, Jones 1988). Three of these species, *Plectorrhiza tridentata* (Lindl.) Dockrill, *Sarcochilus falcatus* R.Br., and *Thelychiton speciosus* (Sm.) M.A. Clem & D.L. Jones, are evergreen epiphytes or lithophytes with a subtropical to tropical distribution (Jones 1988); they are at the southern end of their range in Victoria.

Assessment Criteria

The five major assessment criteria options (A–E) defined in IUCN 2001 varied in their applicability for assessing the conservation status of Victoria's orchids.

Criterion A: Population-Monitoring Data

Application of this criterion relies on having high standard population-monitoring data collected over several generations. Because this information is simply not available for the majority of Victoria's orchids, the criterion could be applied to only four taxa. For three species, *Diuris fragrantissima* D.L. Jones & M.A Clem., *Caladenia rosella* G.W. Carr, and *Calochilus richiae* Nicholls, information on population numbers and decline had been obtained over some years (e.g., Backhouse et al. 1999, Schoknecht 1991, Todd 2000). For one species, *Caladenia toxochila* Tate, a secondary inference of % population change was made by direct observation of the extent of habitat destruction affecting this species.

Criterion A, which was of limited use in this assessment, may not be particularly useful for orchids in general, as the data required are available for very few species. Another issue involved determining generation time for terrestrial orchids. We used an arbitrary generation time of 10 years, but this was a "best guess," based on very little data; however, longevity of some individual terrestrial orchids in Victoria is known to be at least 17 years (Hill et al. 1999).

Time to first flowering from seedlings is as little as 2–3 years in cultivation and ca. 4–5 years in the wild.

Criterion B: Occurrence/Occupancy

Applying Criterion B relies on knowledge of Extent of Occurrence (EO) and/or Area of Occupancy (AO), number of populations and/or degree of fragmentation, and projection of continuing decline in range, habitat, and/or numbers. This information can be readily generated for many orchid species, and the criterion was used for 77 taxa. Many threatened orchids now have restricted, often highly fragmented distributions, particularly in bioregions suffering major habitat disturbance or loss.

Criterion B includes sub-criteria, such as Critically Endangered (CE). Application of this criterion thus can be difficult, as many threatened orchid species easily fit the EO and/or AO subcriteria for Critically Endangered, which accounts for the comparatively few taxa assessed as Endangered. Although these species were experiencing continued decline in range, numbers, and/or habitat, they still occurred in hundreds or thousands of plants at multiple locations. For example, *Diuris* sp. aff. *chryseopsis* 'basalt plains' still may occur in 20 or more populations with a total of several thousand plants. All of these populations, however, are isolated and highly fragmented and exist as tiny remnants in a bioregion where more than 99% of the native grassland habitat has been destroyed (NRE 1997). This distribution pattern was deemed to be "highly fragmented"; and importantly, all remaining populations are experiencing similar threats. Thus this taxon (and other orchids in similar situations) meets the criteria for assessment as Critically Endangered. Many threatened orchids were found to have highly fragmented distributions and only a very small AO, and therefore easily fit Critically Endangered.

Criterion B also includes an option of "extreme fluctuations," which can occur when the population size or distribution area varies widely, rapidly, and frequently, typically with a variation greater than one order of magnitude (i.e., tenfold increase or decrease) (IUCN 2001). This criterion was not found to apply to any Victorian orchid, as there was no evidence that any species experienced a 90% change in numbers or distribution "widely, rapidly and frequently," at least not within generation times.

Criterion C: Continuing Decline of Individuals

Applying Criterion C, which relies on knowledge of numbers of individuals and rate or projection of continuing decline, was used for 54 taxa. All assessments using Criterion C were based on number of individuals and projected decline (rate undetermined). The option C1 "estimation of rate of continuing decline" was not used, as information was insufficient to determine rates of decline confidently.

Criterion D: Total Numbers of Individuals

Applying Criterion D relies on knowledge of total numbers of individuals (for CR, EN, and VU) or total AO and number of sub-populations (options for VU only). This criterion was used for 149 taxa, of which 48 taxa were assessed as CR or EN (where total numbers of individuals are known) and 101 taxa, as VU (15 D1—very small numbers—and 86 D2—very restricted in area). Where taxa were known only from a small area with few populations and/or low numbers of individuals, but the habitat was reasonably secure with no apparent current threats, then the status assessment was based on Criterion D alone. Should further study indicate threatening processes occurring in the target population, these taxa will qualify for assessment at a higher threat category (EN or even CR).

Criterion E: Population Viability

Criterion E was not used, as population viability assessments have not been undertaken for any orchid taxa in Victoria.

Criteria Usefulness

Several of the criterion options available in IUCN 2001 can be readily applied to determine the conservation status of terrestrial orchids. In particular, Criteria B, C, and D were the most frequently applied, with A being of limited use and E unable to be applied. Basic information was available on numbers of individuals and populations, distribution (as Extent of Occurrence and/or Area of Occupancy), and threats to individuals, populations, and habitat; and thus assessments using criteria B, C, and D (either separately or in combination) were readily achieved.

One apparent weakness may be the thresholds for AO and EO, which seem to be quite generous for small organisms such as orchids. For instance, with assessment as VU relying only on an AO of less than 20 km^2, many taxa easily fit that criterion. For many of our orchid species, AO is substantially less than the 10 km^2 threshold for CR (often with total AO measuring hectares or less, i.e., often by two or more orders of magnitude less than the CR threshold).

Area of Occupancy was calculated according to IUCN 2001. With good data on the distribution and location of many threatened orchids in Victoria, AO was able to be determined at a fine

TABLE 1. Conservation status of the orchids of Victoria using IUCN 2001 Red List Categories and Criteria. Note: In column 2, IUCN refers to conservation status: CR = Critically Endangered, DD = Data Deficient, EN = Endangered, EX = Extinct, LC = Least Concern, NT = Near Threatened, RE = Regionally Extinct, and V = Vulnerable. In column 4, R/G refers to regional/global assessment of conservation status: R = regional, G = global.

Scientific name and authority	IUCN	Criteria	R/G
Acianthus caudatus R. Br.	LC		R
Acianthus collinus D.L. Jones	VU	D1+2	R
Acianthus exsertus R. Br.	LC		R
Acianthus pusillus D.L. Jones	LC		R
Burnettia cuneata Lindl.	VU	D2	R
Caladenia aestiva D.L. Jones	VU	D1+2	G
Caladenia alata R. Br.	LC		R
Caladenia alpina R.S. Rogers	LC		R
Caladenia amoena D.L. Jones	CR	B1ab(iii,v)+2ab(iii,iv); C2a(i)	G
Caladenia audasii R.S. Rogers	CR	B1ab(ii,iv,v)+2ab(iii,iv,v); C2a(i); D	G
Caladenia aurantiaca (R.S. Rogers) Rupp	LC		R
Caladenia australis G.W. Carr	VU	D2	R
Caladenia brachyscapa G.W. Carr	RE		R
Caladenia calcicola G.W. Carr	CR	B1ab(iii)+2ab(iii); C2a(i)	G
Caladenia capillata D.L. Jones	LC		R
Caladeia cardiochila Tate	LC		R
Caladenia carnea R. Br. var. *carnea*	LC		R
Caladenia carnea R. Br. var. *subulata* Nicholls	EX		G
Caladenia catenata (Sm.) Druce	LC		R
Caladenia aff. *catenata* (South Gippsland) sensu Jeanes & Backhouse (2000)	VU	D2	G
Caladenia clarkiae D.L. Jones	LC		R
Caladenia clavigera A. Cunn. ex Lindl.	LC		R
Caladenia cleistantha D.L. Jones	DD		R
Caladenia aff. *colorata* (lower Glenelg River) sensu Ross & Walsh (2003)	EN	D	G
Caladenia concolor Fitzg.	CR	B1ab(i-v)+2ab(i-v); C2a(i); D	G
Caladenia aff. *concolor* (Midlands) sensu Jeanes & Backhouse (2000)	EN	D	G
Caladenia congesta R. Br.	LC		R
Caladenia cruciformis D.L. Jones	CR	B1ab(ii,iii,v)+2b(ii,iii,v); C2a(i)	G
Caladenia cucullata Fitzg.	LC		R
Caladenia dilatata R. Br.	VU	D2	R
Caladenia filamentosa R. Br.	LC		R
Caladenia aff. *fitzgeraldii* sensu Jeanes & Backhouse (2002)	VU	D2	G
Caladenia flavovirens G.W. Carr	VU	D1+2	G
Caladenia formosa G.W. Carr	VU	D2	G
Caladenia fragrantissima D.L. Jones & G.W. Carr	CR	B1ab(ii,iii,v)+2ab(ii,iii,v)	G
Caladenia aff. *fragrantissima* (central Victoria) sensu Bishop (1996)	CR	B1ab(v)+2ab(v); C2a(i,ii); D	G
Caladenia aff. *fragrantissima* (Inverleigh) sensu Ross (2000)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii); D	G
Caladenia fulva G.W. Carr	EN	C2a(ii)	G
Caladenia fuscata (Rchb. f.) M.A. Clem. & D.L. Jones	LC		R
Caladenia gracilis R. Br.	LC		R
Caladenia hastata (Nicholls) Rupp	CR	B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v); C2a(ii)	G
Caladenia hildae Pescott & Nicholls	VU	D2	R
Caladenia insularis G.W. Carr	VU	D1+2	G
Caladenia iridescens R.S. Rogers	LC		G
Caladenia aff. *iridescens* (Chapple Vale) sensu Ross (2000)	DD		G
Caladenia latifolia R. Br.	LC		R
aladenia leptochila Fitzg.	DD		R
Caladenia lowanensis G.W. Carr	CR	B1ab(iii,v)+2ab(iii,v)	G

TABLE 1. Continued.

Scientific name and authority	IUCN	Criteria	R/G
Caladenia magnifica (Nicholls) D.L. Jones & G.W. Carr	EX		G
Caladenia maritima D.L. Jones	CR	B1ab(iii)+2ab(iii); C2a(ii)	G
Caladenia mentiens D.L. Jones	LC		R
Caladenia montana G.W. Carr	VU	D2	G
Caladenia oenochila G.W. Carr	EN	B1ab(i-v)+2b(i-v); C2a(i)	G
Caladenia aff. *oenochila* (St Andrews) sensu Jeanes & Backhouse (2000)	CR	B1ab(v)+2ab(v)c2a(i,ii); D	G
Caladenia orientalis (G.W. Carr) Hopper & A.P. Br.	CR	B1ab(i-v)+2ab(i-v)	G
Caladenia ornata (Nicholls) D.L. Jones	VU	D1+2	G
Caladenia parva G.W. Carr	LC		G
Caladenia patersonii R. Br.	EN	D	R
Caladenia phaeoclavia D.L. Jones	LC		R
Caladenia pilotensis D.L. Jones	CR	B1ab(i-v)+2ab(i-v); C2a(i); D	G
Caladenia praecox Nicholls	LC		R
Caladenia prolata D.L. Jones	VU	D2	R
Caladenia pumila R.S. Rogers	EX		G
Caladenia pusilla W.M. Curtis	LC		R
Caladenia reticulata Fitzg.	VU	D1+2	R
Caladenia robinsonii G.W. Carr	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii); D	G
Caladenia rosella G.W. Carr	CR	A2ace; B1ab(i-v)+2ab(i-v); C2a(ii)	G
Caladenia aff. *rosella* (Violet Town) sensu Ross & Walsh (2003)	CR	B1ab(v)+2ab(v); C2a(i,ii); D	G
Caladenia stricta (R.J. Bates) R.J. Bates	VU	D1	R
Caladenia tensa G.W. Carr	VU	D2	R
Caladenia tentaculata Schltdl.	LC		R
Caladenia tessellata Fitzg.	VU	D2+X332	R
Caladenia thysanochila G.W. Carr	EX		G
Caladenia toxochila Tate	EN	A2ace; B1ab(ii,iii,iv)+2ab(ii,iii,iv); C2a(ii)	R
Caladenia transitoria D.L. Jones	LC		R
Caladenia valida (Nicholls) M.A. Clem. & D.L. Jones	CR	B1ab(i-v)+2ab(i-v); C2a(i,ii)	R
Caladenia venusta G.W. Carr	VU	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i); D2	G
Caladenia aff. *venusta* (Kilsyth South) sensu Ross (2000)	CR	B1ab(i-v)+2ab(i-v); C2a(i,ii); D	G
Caladenia aff. *venusta* (Stuart Mill) sensu Ross (2000)	CR	B1ab(iii,v)+2ab(iii,v); C2a(ii); D	G
Caladenia verrucosa G.W. Carr	LC		R
Caladenia versicolor G.W. Carr	VU	D2	G
Caladenia villosissima (G.W. Carr) Hopper & A.P. Br.	DD		G
Caladenia vulgaris D.L. Jones	VU	D1+2	R
Caladenia aff. *vulgaris* (Aireys Inlet) sensu Jeanes & Backhouse (2002)	DD		G
Caladenia xanthochila D. Beardsell & C. Beardsell	CR	B1ab(i-v)+2ab(i-v); C2a(ii)	G
Caladenia species (Dadswells Bridge) sensu Ross (2000)	DD		G
Caleana major R. Br.	LC		R
Calochilus campestris R. Br.	LC		R
Calochilus gracillimus Rupp	LC		R
Calochilus herbaceus Lindl.	VU	D2	R
Calochilus imberbis R.S. Rogers	CR	D	R
Calochilus paludosus R. Br.	LC		R
Calochilus richiae Nicholls	CR	A2ace; B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii); D	G
Calochilus robertsonii Benth.	LC		R
Chiloglottis cornuta Hook. f.	LC		R
Chiloglottis jeanesii D.L. Jones	VU	D2	G
Chiloglottis reflexa (Labill.) Druce	LC		R

TABLE 1. Continued.

Scientific name and authority	IUCN	Criteria	R/G
Chiloglottis seminuda D.L. Jones	DD		R
Chiloglottis trapeziformis Fitzg.	LC		R
Chiloglottis trilabra Fitzg.	LC		R
Chiloglottis valida D.L. Jones	LC		R
Chiloglottis aff. *valida* (alpine) sensu Jeanes & Backhouse (2000)	DD		G
Chiloglottis aff. *valida* (lowland) sensu Jeanes & Backhouse (20000	LC		G
Corunastylis archeri (Hook. f.) D.L. Jones & M.A. Clem.	LC		R
Corunastylis arrecta (D.L. Jones) D.L. Jones & M.A. Clem.	NT		G
Corunastylis ciliata (Ewart & B. Rees) D.L. Jones & M.A. Clem.	VU	D2	R
Corunastylis despectans (Hook. f.) D.L. Jones & M.A. Clem.	LC		R
Corunastylis morrisii (Nicholls) D.L. Jones & M.A. Clem.	LC		R
Corunastylis aff. *morrisii* (Pyrete Ranges) sensu Ross & Walsh (2003)	EN	D	G
Corunastylis nigricans (R. Br.) D.L. Jones & M.A. Clem.	LC		R
Corunastylis nuda (Hook. f.) D.L. Jones & M.A. Clem.	VU	D2	R
Corunastylis nudiscapa (Hook. f.) D.L. Jones & M.A. Clem.	VU	D1	R
Corunastylis aff. *nudiscapa* (Otway Ranges) sensu Ross & Walsh (2003)	CR	D	G
Corunastylis pumila (Hook. f.) D.L. Jones & M.A. Clem.	VU	D1+2	R
Corunastylis aff. *rufa* (Goldfields) sensu Ross & Walsh (2003)	LC		R
Corybas aconitiflorus Salisb.	LC		R
Corybas despectans D.L. Jones & R.C. Nash	VU	D2	R
Corybas diemenicus	LC		R
Corybas aff. *diemenicus* (coastal) sensu Ross (2000)	EN	C2a(i)	G
Corybas aff. *diemenicus* (mountains) sensu Ross (2000)	LC		R
Corybas aff. *diemenicus* (Wilsons Promontory) sensu Jeanes & Backhouse (2002)	DD		G
Corybas fimbriatus (R. Br.) Rchb. f.	LC	NT downgraded through immigration	R
Corybas fordhamii (Rupp) Rupp	VU	D2	R
Corybas hispidus D.L. Jones	VU	D2	R
Corybas incurvus D.L. Jones & M.A. Clem.	LC		R
Corybas unguiculatus (R. Br.) Rchb. f.	LC		R
Cryptostylis erecta R. Br.	CR	C2a(i)	R
Cryptostylis hunteriana Nicholls	EN	C2a(i)	R
Cryptostylis leptochila F. Muell. ex Benth.	LC		R
Cryptostylis subulata (Labill.) Rchb. f.	LC		R
Cyanicula caerulea (R. Br.) Hopper & A.P. Br.	LC		R
Cyrtostylis reniformis R. Br.	LC		R
Cyrtostylis robusta D.L. Jones & M.A. Clem.	LC		R
Dipodium campanulatum D.L. Jones	DD		R
Dipodium hamiltonianum F.M. Bailey	EN	D	R
Dipodium pardalinum D.L. Jones	DD		G
Dipodium punctatum (Sm.) R. Br.	LC		R
Dipodium roseum D.L. Jones & M.A. Clem.	LC		R
Dipodium variegatum M.A. Clem. & D.L. Jones	NT	VU D2 downgraded through immigration	R

TABLE 1. Continued.

Scientific name and authority	IUCN	Criteria	R/G
Diuris behrii Schltdl.	LC		R
Diuris chryseopsis D.L. Jones	LC		R
Diuris aff. *chryseopsis* (basalt plains) sensu Ross & Walsh (2003)	CR	B2ab(i-v)	G
Diuris dendrobioides Fitzg.	CR	B1ab(ii,iii,v)+2ab(ii,iii,v)	R
Diuris aff. *dendrobioides* (Bairnsdale) sensu Bishop (1996)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v)	G
Diuris fragrantissima D.L. Jones & M.A. Clem.	CR	A2ace; B1ab(iii,v)+2ab(iii,v); C2a(i,ii); D	G
Diuris monticola D.L. Jones	LC		R
Diuris ochroma D.L. Jones	VU	D2	G
Diuris orientis D.L. Jones	LC		R
Diuris palustris Lindl.	VU	D2	R
Diuris pardina Lindl.	LC		R
Diuris aff. *pardina* (western Goldfields) sensu Jeanes & Backhouse (2000)	DD		G
Diuris aff. *pedunculata*	DD		G
Diuris punctata Sm. var. *punctata*	VU	B1ab(i-v)+2ab(i-v); D2	R
Diuris sulphurea R. Br.	LC		R
Diuris tricolor Fitzg.	CR	B1ab(iii,v)+2ab(iii,v); C2a(i,ii); D	R
Dockrillia striolata (Rchb. f.) Rauschert subsp. *striolata*	NT	VU D2 downgraded through immigration	R
Eriochilus cucullatus (Labill.) Rchb. f.	LC		R
Gastrodia procera G.W. Carr	LC		R
Gastrodia sesamoides R. Br.	LC		R
Gastrodia vescula D.L. Jones	DD		R
Glossodia major R. Br.	LC		R
Glossodia minor R. Br.	NT	VU D2 downgraded through immigration	R
Hydrorchis orbicularis (R.S. Rogers) D.L. Jones & M.A. Clem.	VU	D2	R
Leporella fimbriata (Lindl.) A.S. George	LC		R
Leptoceras menziesii (R. Br.) Lindl.	LC		R
Lyperanthus suaveolens R. Br.	LC		R
Microtidium atratum (Lindl.) D.L. Jones & M.A. Clem.	LC		R
Microtis arenaria Lindl.	LC		R
Microtis parviflora R. Br.	LC		R
Microtis rara R. Br.	LC		R
Microtis unifolia (G. Forst.) Rchb. f.	LC		R
Orthoceras strictum R. Br.	LC		R
Orthoceras aff. *strictum* sensu Jeanes & Backhouse (2000)	EN	D	G
Paracaleana disjuncta D.L. Jones	CR	D	R
Paracaleana minor (R. Br.) Blaxell	LC		R
Pheladenia deformis (R. Br.) D.L. Jones & M.A. Clem.	LC		R
Plectorrhiza tridentata (Lindl.) Dockrill	NT	VU D2 downgraded through immigration	R
Prasophyllum alpestre D.L. Jones	LC		R
Prasophyllum appendiculatum Nicholls	VU	D2	R
Prasophyllum australe R. Br.	LC		R
Prasophyllum brevilabre (Lindl.) Hook. f.	LC		R
Prasophyllum chasmogamum R.J. Bates & D.L. Jones	CR	B1ab(i-v)+2ab(i-v); C2a(ii)	G
Prasophyllum colemaniae R.S. Rogers	EX		G
Prasophyllum correctum D.L. Jones	CR	B1ab(i-v)+2ab(i-v); C2a(ii)	G
Prasophyllum diversiflorum Nicholls	CR	B1ab(iii,v)+2ab(iii,v)	G
Prasophyllum aff. *diversiflorum* (Orford) sensu Rouse (2002)	CR	B1ab(iii,v)+2ab(iii,v); D	G
Prasophyllum aff. *diversiflorum* (north-east gilgai)	CR	B1ab(i-v)+2ab(i-v); C2a(i); D	G

TABLE 1. Continued.

Scientific name and authority	IUCN	Criteria	R/G
Prasophyllum elatum R. Br.	LC		R
Prasophyllum aff. *fitzgeraldii* A sensu Rouse (2002)	CR	B1ab(i-v)+2ab(i-v); C2a(i,ii); D	G
Prasophyllum aff. *fitzgeraldii* B sensu Rouse (2002)	DD		R
Prasophyllum aff. *fitzgeraldii* C sensu Rouse (2002)	CR	D	G
Prasophyllum aff. *fitzgeraldii* D sensu Rouse (2002)	DD		R
Prasophyllum flavum R. Br.	LC		R
Prasophyllum fosteri D.L. Jones	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii); D	G
Prasophyllum frenchii F. Muell.	CR	B1ab(i-v)+2ab(i-v)	G
Prasophyllum aff. *frenchii* (Wilsons Promontory) sensu Jeanes & Backhouse 2000	CR	B1ab(iii)+2ab(iii); D	G
Prasophyllum aff. *frenchii* A sensu Rouse (2002)	CR	B1ab(i-v)+2ab(i-v)	G
Prasophyllum aff. *frenchii* B sensu Rouse (2002)	CR	D	G
Prasophyllum hygrophilum D.L. Jones and T.D. Rouse	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(ii)	G
Prasophyllum lindleyanum Rchb. f.	VU	D1	R
Prasophyllum litorale R.J. Bates	VU	D2	R
Prasophyllum aff. *montanum* A sensu Rouse (2002)	VU	D2	G
Prasophyllum aff. *montanum* B sensu Rouse (2002)	DD		G
Prasophyllum morganii Nicholls	EX		G
Prasophyllum niphopedium D.L. Jones	CR	B1ab(i-v)+2ab(i-v)	G
Prasophyllum aff. *occidentale* A sensu Rouse (2002)	VU	D2	G
Prasophyllum aff. *occidentale* C sensu Rouse (2002)	CR	B1ab(i-v)+2ab(i-v)	G
Prasophyllum aff. *occidentale* D sensu Rouse (2002)	CR	B1ab(i-v)+2b(i-v); C2a(i)	G
Prasophyllum aff. *occidentale* E sensu Rouse (2002)	CR	B1ab(i-v)+2b(i-v)	G
Prasophyllum aff. *occidentale* F sensu Rouse (2002)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii); D	G
Prasophyllum aff. *odoratum* A sensu Rouse (2002)	LC		R
Prasophyllum aff. *odoratum* B sensu Rouse (2002)	VU	D2	G
Prasophyllum aff. *odoratum* C sensu Rouse (2002)	VU	D1+2	G
Prasophyllum aff. *odoratum* sensu Rouse (2002)	VU	D1+2	G
Prasophyllum aff. *odoratum* E sensu Rouse (2002)	CR	D	G
Prasophyllum aff. *odoratum* F sensu Rouse (2002)	VU	D2	G
Prasophyllum aff. *odoratum* G sensu Rouse (2002)	VU	D2	G
Prasophyllum aff. *odoratum* H sensu Rouse (2002)	VU	D2	G
Prasophyllum aff. *odoratum* I sensu Rouse (2002)	DD		G
Prasophyllum aff. *odoratum* J sensu Rouse (2002)	EN	D	G
Prasophyllum aff. *odoratum* K sensu Rouse (2002)	VU	D2	G
Prasophyllum aff. *odoratum* L sensu Rouse (2002)	VU	D2	G

TABLE 1. Continued.

Scientific name and authority	IUCN	Criteria	R/G
Prasophyllum aff. *odoratum* M sensu Rouse (2002)	EX		G
Prasophyllum parviflorum (R.S. Rogers) Nicholls	VU	D2	G
Prasophyllum aff. *parviflorum* (southwest Victoria) sensu Rouse (2002)	CR	D	G
Prasophyllum aff. *petilum* (Wangaratta) sensu Rouse (2002)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii)	G
Prasophyllum aff. *petilum* (Murchison)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii)	G
Prasophyllum pyriforme E. Coleman	CR	B1ab(i-v)+2ab(i-v); C2a(i,ii)	G
Prasophyllum aff. *pyriforme* A sensu Rouse (2002)	EN	D	G
Prasophyllum aff. *pyriforme* B sensu Rouse (2002)	CR	D	G
Prasophyllum aff. *pyriforme* C sensu Rouse (2002)	EN	C2a(i)	G
Prasophyllum aff. *pyriforme* E sensu Rouse (2002)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii); D	G
Praosphyllum aff. *pyriforme* (Chesney)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v)	G
Prasophyllum sphacelatum D.L. Jones	NT	VU D2 downgraded through immigration	R
Prasophyllum spicatum R.J. Bates & D.L. Jones	CR	B1ab(i-v)+2ab(i-v); C2a(i)	G
Prasophyllum suaveolens D.L. Jones & R.J. Bates	CR	B1ab(i-v)+2ab(i-v)	G
Prasophyllum subbisectum Nicholls	EN	D (close to CR)	G
Prasophyllum suttonii R.S. Rogers & B. Rees	EX		G
Prasophyllum sylvestre R.J. Bates & D.L. Jones	VU	D1+2	R
Prasophyllum tadgellianum R.S. Rogers	LC		R
Prasophyllum aff. *validum* A sensu Rouse (2002)	VU	D2	G
Prasophyllum aff. *validum* B sensu Rouse (2002)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v)	G
Pterostylis aciculiformis (Nicholls) M.A. Clem. & D.L. Jones	LC		R
Pterostylis aff. *aciculiformis* (Beechworth) sensu Jeanes & Backhouse (2000)	CR	D	G
Pterostylis aff. *aciculiformis* (Stawell) sensu Ross (2000)	DD		G
Pterostylis aestiva D.L. Jones	VU	D2	R
Pterostylis aff. *alata* (coastal) sensu Ross & Walsh (2003)	DD		G
Pterostylis alpina R.S. Rogers	LC		R
Pterostylis aff. *alpina* (Wilsons Promontory) sensu Jeanes & Backhouse (2000)	DD		G
Pterostylis alveata Garnet	VU	D2	R
Pterostylis aff. *alveata* (montane) sensu Ross (2000)	VU	D2	G
Pterostylis atrans D.L. Jones	LC		R
Pterostylis baptistii Fitzg.	VU	D2	R
Pterostylis basaltica D.L. Jones & M.A. Clem.	CR	B1ab(i-v)+2ab(i-v)	G
Pterostylis bicolor M.A. Clem. & D.L. Jones	VU	D2	R
Pterostylis aff. *bicolor* (Woorndoo) sensu Ross (2000)	CR	B1ab(i-v)+2ab(i-v); C2a(ii)	G
Pterostylis aff. *biseta* (Lara) sensu Ross & Walsh (2003)	EX		G
Pterostylis aff. *biseta* (Pink Lakes) sensu Ross (2000)	VU	D2	G
Pterostylis boormanii Rupp	VU	D2	R
Pterostylis aff. *boormanii* (Beechworth) sensu Backhouse & Jeanes (1995)	CR	D	G

TABLE 1. Continued.

Scientific name and authority	IUCN	Criteria	R/G
Pterostylis aff. *boormanii* (Sunset Country) sensu Ross (2000)	VU	D2	G
Pterostylis cheraphila D.L. Jones & M.A. Clem.	VU	D2	G
Pterostylis chlorogramma D.L. Jones & M.A. Clem.	VU	D1	G
Pterostylis coccina Fitzg.	VU	D2	R
Pterostylis concinna R. Br.	LC		R
Pterostylis cucullata (coastal form) sensu Jeanes & Backhouse (2000)	EN	B1ab(i-v)+2ab(i-v)	R
Pterostylis cucullata (montane form) sensu Jeanes & Backhouse (2000)	VU	D2	G
Pterostylis curta R. Br.	LC		R
Pterostylis cycnocephala Fitzg.	LC		R
Pterostylis aff. *cycnocephala* (alpine) sensu Bishop (1996)	LC		R
Pterostylis aff. *cycnocephala* (Woorndoo) sensu Ross & Walsh (2003)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii); D	G
Pterostylis decurva R.S. Rogers	LC		R
Pterostylis despectans (Nicholls) M.A. Clem. & D.L. Jones	CR	B1ab(i-v)+2ab(i-v)	G
Pterostylis aff. *despectans* (Terrick Terrick)	CR	D	G
Pterostylis dolichochila D.L. Jones & M.A. Clem.	VU	D2	R
Pterostylis aff. *dolichochila* (Portland) sensu Bishop (1996)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(ii)	G
Pterostylis aff. *excelsa* sensu Backhouse & Jeanes (1995)	EN	D	R
Pterostylis falcata R.S. Rogers	LC		R
Pterostylis fischii Nicholls	NT	VU D2 downgraded through immigration	R
Pterostylis foliata Hook. f.	LC		R
Pterostylis aff. *furcata* (Woolly Teatree) sensu Ross (2000)	VU	B1ab(i-v); C2a(i); D2	G
Pterostylis grandiflora R. Br.	EN	B1ab(ii,iii,iv)+2ab(ii,iii,iv)	R
Pterostylis hamata Blackmore & Clemesha	VU	D2	R
Pterostylis laxa Blackmore	NT	VU D2 downgraded through immigration	R
Pterostylis aff. *longifolia* (Mount Hamilton) sensu Bishop (1996)	DD		G
Pterostylis maxima M.A. Clem. & D.L. Jones	VU	B1ab(i-v)+2ab(i-v)	R
Pterostylis melagramma D.L. Jones	LC		R
Pterostylis aff. *melagramma* (montane 'pale green') sensu Ross & Walsh (2003)	VU	D2	G
Pterostylis aff. *melagramma* (northwest) sensu Ross & Walsh (20030	VU	D2	G
Pterostylis aff. *melagramma* (Stawell) sensu Ross & Walsh (2003)	VU	D2	G
Pterostylis monticola D.L. Jones	LC		R
Pterostylis mutica R. Br.	LC		R
Pterostylis aff. *mutica* (basalt plains) sensu Bishop (1996)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(ii)	G
Pterostylis nana R. Br.	LC		R
Pterostylis nutans R. Br.	LC		R
Pterostylis oreophila Clemesha	EN	B1ab(iii,iv)+2ab(iii,iv)	R
Pterostylis parviflora R. Br.	LC		R
Pterostylis aff. *parviflora* (northern Victoria) sensu Ross & Walsh (2003)	LC		R
Pterostylis aff. *parviflora* (southern Victoria) sensu Ross & Walsh (2003)	DD		R
Pterostylis pedoglossa Fitzg.	VU	D2	R

TABLE 1. Continued.

Scientific name and authority	IUCN	Criteria	R/G
Pterostylis pedunculata R. Br.	LC		R
Pterostylis planulata D.L. Jones & M.A. Clem.	DD		R
Pterostylis aff. *plumosa* (Anglesea) sensu Bishop (1996)	VU	D2	G
Pterostylis aff. *plumosa* (Mallee) sensu Bishop (1996)	VU	D2	R
Pterostylis aff. *plumosa* (woodland) sensu Jeanes & Backhouse (2000)	VU	D2	R
Pterostylis pusilla R.S. Rogers	LC		R
Pterostylis reflexa R. Br	VU	D2	R
Pterostylis aff. *revoluta* sensu Jeanes & Backhouse (2000)	LC		R
Pterostylis robusta (Ewart) R.S. Rogers	LC		R
Pterostylis sanguinea D.L. Jones & M.A. Clem.	LC		R
Pterostylis setifera M.A. Clem., Mathias & D.L. Jones	VU	D2	R
Pterostylis smaragdyna D.L. Jones & M.A. Clem.	VU	B1ab(i-v)+2ab(i-v); C2a(i); D2	G
Pterostylis squamata R. Br.	LC		R
Pterostylis striata Fitzg.	LC		R
Pterostylis aff. *striata* (Silurian) sensu D.L. Jones (unpubl. data)	CR	B1ab(i-v)+2ab(i-v)	G
Pterostylis tasmanica D.L. Jones	VU	D2	R
Pterostylis tenuissima Nicholls	EN	C2a(i)	G
Pterostylis truncata Fitzg.	CR	B1ab(i-v)+2ab(i-v)	R
Pterostylis tunstallii D.L. Jones & M.A. Clem.	VU	D2	R
Pterostylis uliginosa D.L. Jones	EN	D	R
Pterostylis valida (Nicholls) D.L. Jones	EX		G
Pterostylis woollsii Fitzg.	CR	B1ab(ii,iii,v)+2ab(ii,iii,v); C2a(i,ii); D	R
Pterostylis xerophila M.A. Clem.	VU	D2	R
Pyrorchis nigricans (R. Br.) D.L. Jones & M.A. Clem.	LC		R
Sarcochilus australis (Lindl.) Rchb. f.	LC		R
Sarcochilus falcatus R. Br.	VU	EN C2a(i) downgraded through immigration	R
Spiranthes australis (R. Br.) Lindl.	LC		R
Thelychiton speciosus (Sm.) M.A. Clem. & D.L. Jones	VU	EN C2a(i) downgraded through immigration	R
Thelymitra antennifera (Lindl.) Hook. f.	LC		R
Thelymitra arenaria Lindl.	LC		R
Thelymitra aristata Lindl.	LC		R
Thelymitra atronitida Jeans	VU	D2	R
Thelymitra azurea R.S. Rogers	VU	D2	R
Thelymitra basaltica Jeanes	CR	B1ab(i-v)+2ab(i-v)	G
Thelymitra benthamiana Rchb. f.	VU	D2	R
Thelymitra bracteata J.Z. Weber ex Jeanes	CR	D	R
Thelymitra brevifolia Jeanes	LC		R
Thelymitra carnea R. Br.	LC		R
Thelymitra circumsepta Fitzg.	VU	D2	R
Thelymitra cyanea (Lindl.) Benth.	LC		R
Thelymira epipactoides F. Muell.	EN	B1ab(i-v)+2ab(i-v); C2a(i)	R
Thelymitra erosa D.L. Jones & M.A. Clem. Subsp. nov. 1	CR	B1ab(iv,v)+2ab(iv,v); C2a(ii)	G
Thelymitra erosa D.L. Jones & M.A. Clem. Subsp. nov. 2	EN	B1ab(iii,iv,v)+2ab(iii,iv,v); C2a(i)	R
Thelymitra exigua Jeanes	LC		R
Thelymitra flexuosa Endl.	LC		R
Thelymitra gregaria D.L. Jones & M.A. Clem.	CR	B1ab(i-v)+2ab(i-v)	G

TABLE 1. Continued.

Scientific name and authority	IUCN	Criteria	R/G
Thelymitra hiemalis D.L. Jones & M.A. Clem.	CR	B1ab(i-v)+2ab(i-v); C2a(i); D	G
Thelymitra holmesii Nicholls	LC		R
Thelymitra improcera D.L. Jones & M.A. Clem.	VU	D2	R
Thelymitra inflata Jeanes	VU	D2	R
Thelymitra ixioides Sw.	LC		R
Thelymitra juncifolia Lindl.	LC		R
Thelymitra longiloba D.L. Jones & M.A. Clem.	EN	D	R
Thelymitra lucida Jeanes	LC		R
Thelymitra luteocilium Fitzg.	LC		R
Thelymitra mackibbinii F. Muell.	CR	B1ab(i-v)+2ab(i-v); C2a(i); D	G
Thelymitra malvina M.A. Clem., D.L. Jones & Molloy	VU	D2	R
Thelymitra matthewsii Cheeseman	VU	D2	R
Thelymitra media R. Br.	LC		R
Thelymitra megcalyptra Fitzg.	LC		R
Thelymitra aff. *megcalyptra* (alpine) sensu Ross (unpubl. data)	LC		R
Thelymitra aff. *megcalyptra* (northwest) sensu Ross (unpubl. data)	LC		R
Thelymitra mucida Fitzg.	EN	D	R
Thelymitra nuda R. Br.	LC		R
Thelymitra pallidiflora Jeanes	VU	D2	G
Thelymitra pauciflora R. Br.	LC		R
Thelymitra aff. *pauciflora* (reflexed) sensu Ross (unpubl. data)	CR	B1ab(ii,iii,v)+2ab(ii,iii,v)	G
Thelymitra peniculata Jeanes	EN	D	R
Thelymitra planicola Jeanes	VU	D2	G
Thelymitra rubra Fitzg.	LC		R
Thelymitra simulata D.L. Jones & M.A. Clem.	VU	D2	R
Thynninorchis huntianus (F. Muell.) D.L. Jones & M.A. Clem.	LC		R

scale (e.g., hectares or even square meters) for many species, and the final calculations were quite small. The application rules for determining AO state that the size of AO should be at a scale appropriate to the relevant biological aspects of the taxon, the nature of the threats, and the available data (IUCN 2001). The biological justifications for calculating AO at a smaller, rather than larger, scale for terrestrial orchids include the microclimatic conditions required by many terrestrial orchids and the sporadic distribution of mycorrhizal fungi across a particular habitat (e.g., Masuhara & Katsuya 1994, Perkins & McGee 1995, Perkins et al. 1995). Another justification is the small home ranges or territories of typical insect pollinators (e.g., Naumann 1991, Bower 1996). Even being generous with area measurements, such as including individual outliers in populations rather than calculating these separately (thereby increasing AO), the total AO for many threatened terrestrial orchids in Victoria would still be measured in tens of hectares or less.

Comparison with Other Assessments

Previous assessments of the number of Threatened (EN+VU) orchids in Victoria (TABLE 2) gave figures of 33% (Backhouse & Jeanes 1995), 30% (Ross 2000), and 34% (DSE 2003). The current assessment, which used IUCN 2001 results in 53% of Victoria's orchids, considered Threatened (CR+EN+VU), a figure well in excess of previous studies.

Although earlier assessment systems did not have Critically Endangered as a threat category, they did include the category Rare, which was not considered a threat category. Of the 45 taxa assessed as Rare in DSE (2003), 30 taxa were assessed as VU in the current study, with the remainder as CR (1 taxon), EN (1 taxon), NT (5 taxa), DD (4 taxa), and only three as LC. By taking into account the additional categories for the broader term Conservation Concern in the earlier assessments (i.e., Threatened + Extinct + Rare + Insufficiently Known), the figures increase to 52% (Backhouse & Jeanes 1995), 59%

TABLE 2. Comparison of conservation status assessments for the orchids of Victoria.

Category*	Backhouse & Jeanes (1995)		Ross (2000)		DSE (2003)		Backhouse & Cameron (current study)				
	N	%	N	%	N	%	Global	%	Regional	%	Total	%
Extinct (EX)	3	1	7	2	11	3	10	2.7	1	0.3	11	3
Critically Endangered (CR)	—	—	—	—	—	—	70	18.8	9	2.4	79	21
Endangered (EN)	50	19	53	16	73	22	12	3.3	14	3.7	26	7
Vulnerable (VU)	37	14	45	14	41	12	38	10.2	54	14.5	92	25
Threatened (Thrt) (EN+VU or CR+EN+VU)	87	33	98	30	114	34	120	32.3	77	20.6	197	53
Rare (Ra)	26	10	33	10	45	13	—	—	—	—	—	—
Near Threatened (NT)	—	—	—	—	—	—	1	0.3	7	1.9	8	2
Insufficiently Known (IK)	20	8	53	16	51	15	—	—	—	—	—	—
Data Deficient (DD)	—	—	—	—	—	—	15	4	9	2.4	24	6
Conservation Concern (CC) (Thrt+EX+RA+IK or Thrt+EX+NT+DD)	136	52	191	59	221	65	146	39.3	94	25.2	240	65
Secure/Least Concern	125	48	134	41	119	35	3	0.8	129	34.7	132	35
Orchid taxa total numbers	261	100	325	100	340	100	146	39.2	226	60.8	372	100

* Category entries comprise all the categories used in all the classification systems. Dashes in the Table denote where a particular category was not used in that system.

(Ross 2000), and 65% (DSE 2003); the latter estimates accord well with the current study. Using the IUCN 2001 categories has not resulted in any increase in the proportion of native orchids considered of Conservation Concern in Victoria.

The large degree of accord with recent assessments (e.g., Ross 2000, DSE 2003) using the older, more subjective assessment criteria suggests that few major differences exist when determining the overall number of species of Conservation Concern. What did occur was a reassignment of those taxa among the new categories in IUCN 2001. Surprisingly the previous subjective assessment systems seem to have worked well in providing an indication of number of taxa of Conservation Concern. This is likely the result of regular review and update of conservation status at the state level, as new information has become available.

DISCUSSION

Are more than half of Victoria's orchids really threatened? The high number of threatened orchids (and indeed other threatened flora and fauna) in Victoria can be placed in perspective, considering the impact of more than 150 years of European settlement on the landscape. This impact has been well documented (e.g., Frood & Calder 1987, NRE 1997, Scarlett & Parsons 1993).

More than 60% of Victoria is private land, and about 95% of this private land has been cleared principally for agriculture but also for industrial and urban development (Frood & Calder 1987). This impact has fallen unevenly across the landscape. Some habitats, such as native grasslands and grassy woodlands that once covered ca. 33% of Victoria, have been mostly destroyed, with less than 1% remaining. Only ca. 30% of dry box-ironbark forest complexes and deep freshwater marshes remain (NRE 1997). In contrast, some habitats such as montane moist forests and sub-alpine woodland complexes remain substantially intact, with less than 20% reduction in their former extent (NRE 1997).

In addition to habitat reduction, other threats include rising soil salinity levels and predation from alien and native herbivores. Competition from invasive alien plant species is an enormous problem. More than 1200 species of alien plants, plus other translocated non-endemic native plants, are now naturalized in Victoria, comprising ca. 28% of the state's flora (Carr 1993, Ross & Walsh 2003); such plants have a major impact on ecosystems through competition and habitat change (Carr 1993, Costello et al. 2000).

Clearly the impact of this change on native fauna and flora, including orchids, has been substantial. The totals of 53% of Victoria's native orchid being Threatened and 65% of Conservation Concern are an accurate reflection of the real level of environmental change and threats occurring in Victoria.

Taxonomy

Further taxonomic work on Victoria's orchids is essential, given the large proportion of putative undescribed taxa (105 taxa forming 28% of Victoria's orchid flora). Uncertainty over a taxon's identity can delay initiation of conservation measures, with managers understandably reluctant to commit limited resources to an essentially unknown entity. We need to be at least aware, however, of these taxa and their status, and not close off any options that might compromise future recovery once their taxonomy is clarified.

National and International Lists

Of the 208 orchids classified as Extinct or Threatened in Victoria under this assessment, only 73 have been formally listed as Threatened under Victorian biodiversity legislation (Flora and Fauna Guarantee Act 1988). While the assessments of 130 of these taxa are effectively national (global) assessments, only 54 are currently included under the Schedules of Threatened Species in the Commonwealth EPBC Act (3 EX, 1 CR, 26 EN, 24 VU).

Currently, no Victorian orchid (or Australian orchid) is included on the IUCN Red List of Threatened Species 2003. Indeed, orchids as a family seem to be substantially under-represented, with only 22 species included. Further listing of threatened orchids under State and Commonwealth biodiversity legislation, and nomination for the IUCN Red List is highly desirable, if only to further recognize the magnitude of the problem of decline and loss of biodiversity in Victoria.

Conclusions

The IUCN 2001 Red List Categories and Criteria have proven a useful tool in assessing the conservation status of Victoria's orchids. The more objective assessment criteria provide for improved objectivity and repeatability of these assessments (IUCN 1994). Extensive assessment of a group of taxa, however, relies on a reasonable level of information on distribution, abundance, operation of threats to populations and habitats. Such an assessment is quite time consuming. A major problem with the current assessment was the length of time taken for the process, both in receiving completed data sheets from respondents and in completing the actual assessments, which were undertaken by us on a part-time capacity over 2 years. The data-intensive nature of the assessment makes such a process unavoidable. An assessment of the 260 taxa of plants endemic to the Galapagos Islands took 3.5 years (CDF 2001). The challenge in applying IUCN 2001 to more than 3000 taxa of native vascular plants becomes daunting, although a similar level of systematic application already has been undertaken for Ecuador's flora (more than 4000 taxa; Valencia et al. 2000). The extended time period has obvious implications for consistency, so the final assessments were reassessed twice more to ensure that a consistent interpretive approach had been obtained.

Once the initial assessments have been undertaken using the new criteria, updates will be relatively quick and easy, however, as new information is incorporated. Proficiency with application of IUCN 2001 comes with experience, and new practitioners require basic training and practice in application before embarking on an extensive assessment program. RAMAS® Red List is a software program designed for applying IUCN 2001 (Applied Biomathematics 2003). Although it was not used in this study, its application has the potential to further facilitate assessments and reduce subjectivity, especially as it can incorporate uncertainties in the input data.

When regional assessments are undertaken, decision rules, based on the biological and ecological characteristics of the taxa under investigation, may need to be developed. This is especially the case when determining the likelihood of immigration affecting extinction probability of the target populations. In practice, for orchids, the chances of successful population supplementation or establishment via immigration are probably very small. Dispersal is also random, and with the distance required for seed to travel, and very low rates of seedling establishment, the probability of successful establishment and population supplementation or creation is quite low. Although immigration might be a possibility over long time scales (e.g., hundreds or thousands of years), the timeframe of conservation managers is much more limited (typically years or decades). Therefore the probability of immigration having an impact on extinction risk within this timeframe is low, and reliance on immigration is probably an impractical conservation measure for almost all threatened orchids in Victoria. The interpretation and application of regional assessment is perhaps the most controversial area of this study, and one that in reality is very difficult to test.

A logical next step in the assessment process is close cooperation with adjoining states to pool information on orchids spanning state borders. This will enable a much greater proportion of regional conservation status assessments of orchids in southeastern Australia to become global conservation assessments.

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Literature Cited

Applied Biomathematics. 2003. RAMAS® Red List version 2.0. Threatened Species Classification under Uncertainty. Applied Biomathematics, New York.

Backhouse, G.N. and J.A. Jeanes. 1995. The Orchids of Victoria. The Miegunyah Press, Carlton.

Backhouse, G., A. Webster, and J. Arnott. 1999. Recovery Plan for the Sunshine Diuris *Diuris fragrantissima* (Orchidaceae: Diuridinae) 1998–2002. Department of Natural Resources and Environment, Melbourne.

Bishop, T. 1996. Field Guide to the Orchids of New South Wales and Victoria. University of New South Wales Press, Sydney.

Bower, C.C. 1996. Demonstration of pollinator-mediated reproductive isolation in sexually deceptive species in *Chiloglottis* (Orchidaceae: Caladeniinae). Aust. J. Bot. 44: 15–33.

Cameron, D., F. Cross, S. Leech, and P. Wierzbowski. 1998. Victorian Flora Species List. Department of Natural Resources and Environment, Mebourne.

Carr, G.W. 1993. Exotic flora of Victoria and its impact on indigenous biota. Pp. 256–297 *in* D.B. Forman and N.G. Walsh, eds. Flora of Victoria, Vol. 1. Introduction. Inkata Press, Melbourne.

CDF. 2001. Completion of the new Red List evaluation of the endemic plants of Galapagos. Charles Darwin Foundation for the Galapagos Islands (CDF), Puerto Ayora, Ecuador.

Costello, D.A., I.D. Lunt, and J.E. Williams. 2000. Effects of invasion by the indigenous shrub *Acacia sophorae* on plant composition of coastal grasslands in south-eastern Australia. Biol. Cons. 96(1): 113–121.

Cross, F., S. Leech, C. Boyle, and D. Cameron. 2001. Victorian Flora Species Index. Department of Natural Resources and Environment, Melbourne.

Dressler, R.L. 1981. The Orchids: Natural History and Classification. Harvard University Press, Cambridge and London.

DSE. 2003. Advisory List of Rare or Threatened Plants in Victoria. Department of Sustainability and Environment, Melbourne.

———. 2004. Flora Information System. Department of Sustainability and Environment, Melbourne.

Duncan, J.S., ed. 1982. Atlas of Victoria. Government Printer, Melbourne.

Frood, D. and M. Calder. 1987. Nature Conservation in Victoria. Victorian National Parks Association, Melbourne.

Gullan, P.K., D.C. Cheal, and N.G. Walsh. 1990. Rare or Threatened Plants of Victoria. Department of Conservation and Environment, Melbourne.

Hill, J., G.W. Carr, A. Pritchard, A. Govanstone, and G.N. Backhouse. 1999. Recovery Plan for Mellblom's Spider-orchid *Caladenia hastata* (Orchidaceae: Caladeniinae) 1998–2002. Portland Aluminium and Department of Natural Resources and Environment, Melbourne.

IUCN. 1980. How to Use the IUCN Red Data Book Categories. International Union for the Conservation of Nature and Natural Resources (World Conservation Union) IUCN Threatened Plants Committee Secretariat, Kew.

———. 1994. IUCN Red List Categories. IUCN Species Survival Commission. IUCN, Gland.

———. 2001. IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland and Cambridge.

———. 2003. Guidelines for Application of IUCN Red List Criteria at Regional Levels. Version 3.0. IUCN Species Survival Commission. IUCN, Gland and Cambridge.

Jeanes, J.A. and G.N. Backhouse. 2000. Wild Orchids of Victoria, Australia. Zoonetics ER Books, Melbourne.

———. 2002. Wild Orchids of Victoria, Australia. Revised edition. Zoonetics ER Books, Melbourne.

Jones, D.L. 1988. Native Orchids of Australia. Reed Books, Sydney.

Leigh, J.H., J.D. Briggs, and W. Hartley. 1981. Rare or Threatened Australian Plants. Australian National Parks and Wildlife. Special Publication No. 7. ANPW, Canberra.

Masuhara, G. and K. Katsuya. 1994. In situ and in vitro specificity between *Rhizoctonia* spp. and *Spiranthes sinensis* (Persoon) Ames. var. *amoena* (M. Bieberstein) Hara (Orchidaceae). New Phytol. 127: 711–718.

Naumann, F.A. 1991. Hymenoptera. Pp. 916–1000 *in* F.A. Naumann, ed. The Insects of Australia. Melbourne University Press, Carlton.

NRE. 1997. Victoria's Biodiversity: Directions in Management. Department of Natural Resources and Environment, Melbourne.

———. 2000. Rare or Threatened Plants in Victoria. Department of Natural Resources and Environment, Melbourne.

Partomihardjo, T. 2003. Colonisation of orchids on the Krakatau islands. Telopea 1: 299–310.

Perkins, A.J. and P.A. McGee. 1995. Distribution of the orchid mycorrhizal fungus, *Rhizoctonia solani,* in relation to its host, *Pterostylis acuminata,* in the field. Aust. J. Bot. 43: 565–575.

Perkins, A.J., G. Masuhara, and P.A. McGee. 1995. Specificity of the +associations between *Microtis parviflora* (Orchidaceae) and its mycorrhizal fungi. Aust. J. Bot. 43: 85–91.

Rasmussen, H.N. 1995. Terrestrial Orchids from Seed

to Mycotrophic Plant. Cambridge University Press, Cambridge.
Ross, J.H. 2000. A Census of the Vascular Plants of Victoria. 6th ed. Royal Botanic Gardens and Herbarium, Melbourne.
Ross, J. and N.G. Walsh. 2003. Census of the Vascular Plants of Victoria, 7th ed. Royal Botanic Gardens and Herbarium, Melbourne.
Rouse, D.T. 2002. Report on the Taxonomic, Ecological, and Conservation Status of Taxa in the Genus *Prasophyllum* R.Br. in South-Eastern Australia. Report to Australian Orchid Foundation, Essendon.
Scarlett, N.H. and R.F. Parsons. 1993. Rare or Threatened Plants of Victoria. Pp. 227–255 *in* D.B. Forman and N.G. Walsh, eds. Flora of Victoria, Vol. 1. Introduction. Inkata Press, Melbourne.
Schoknecht, N. 1991. Bald-tip Beard-orchid *Calochilus richiae* Action Statement No. 5. Department of Conservation and Environment, Melbourne.
Todd, J.A. 2000. Recovery Plan for Twelve Threatened Spider-orchids, *Caladenia* R. Br. Taxa of Victoria and South Australia, 2000–2004. Victorian Department of Natural Resources and Environment, Melbourne.
Valencia, R., N. Pitman, S. León-Yánez, and P.M. Jørgensen, eds. 2000. Libro Rojo de las Plantas Endémicas del Ecuador 2000. Publicaciones del Herbario QCA, Ponticicia Universidad Católica del Ecuador, Quito.